A regional perspective on the Mobulid Ray interactions with surface fisheries in the Indian Ocean

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Abstract

Mobulids are globally threatened with the risk of extinction due to high levels of bycatch and direct exploitation throughout their range. In addition, the concern about mobulid products being internationally traded has resulted in all species being listed on CITES Appendix II. At its 22nd session, the IOTC decided not to adopt conservation and management measures for *Mobula* species due to a lack of evidence on their interactions with surface tuna fisheries. This report reviews the available information on mobulid interaction with surface tuna fisheries in the IOTC Area of Competence. Mobulids are mainly caught as bycatch in industrial purse-seine and at a lesser extent in longline fisheries. They are also incidentally captured in small-scale gillnet fisheries, but usually used for both meat and gill plates (high value in some Asian medicine markets). The mobulids are currently listed on the IUCN Red List as globally Endangered (*Mobula mobular*), Vulnerable (*M. alfredi, M. birostris, M. rochebrunei,* and *M. tarapacana*), Near Threatened (*M. eregoodootenkee, M. japanica, M. munkiana,* and *M. thurstoni*) or Data Deficient (*M. hypostoma,* and *M. kuhlii*). However many of these listings are now out of date and are likely to underrepresent current threat levels. Out of eleven, four species show declining trends (*M. alfredi, M. birostris, M. kuhlii,* and *M. mobular*) whereas the status of other species remains unknown due to poor data availability. Although in some countries mobulids are protected and/or restrictions on fishing and trade have been imposed, the effectiveness of implementation of such measures depends on the availability, reliability, and sharing of scientific knowledge and evidence on its interactions with certain fisheries, for instance tuna/surface fisheries.

Introduction

Mobulids (manta and mobula/devil rays; *Mobula* spp.) are vulnerable to population declines due to their slow growth rates, low productivity, and longevity (Stevens et al., 2004; Dulvy et al., 2014). These K-selected species are threatened by overfishing and bycatch throughout their range as a result of being directly targeted or retained as secondary catch in small-scale fisheries (Notarbartolo-di-Sciara, 1988; White et al., 2006; Rohner et al., 2013), and captured as bycatch in industrial fisheries (Paulin et al., 1982; White et al., 2006). Furthermore, these species are likely to have a poor ability to withstand even low levels of fishing mortality because they have small, fragmented and isolated populations that often occur in surface coastal waters, and are therefore relatively easy to locate and exploit (Ward-Paige et al., 2013).

The primary driver for mobulid fisheries is the gill plate trade and at certain landing sites, the consumption of fresh mobulid meat. The extent of their exploitation is reported by the Food and Agriculture Organization (FAO) based on landings data. It was observed from 1998 to 2010 that a total of 20,707 metric tons (MT) of mobulids were landed by four countries (Indonesia, Liberia and others), with an average of 1,593 MT per year. Among these Indonesia was by far the highest (82%), followed by Liberia (18%). However, most countries are not systematically reporting mobulids in fisheries data and in many cases only estimates are available based on limited catch reporting. It is highly likely that the global database reflects only a fraction of the known fishing related mortality for mobulids (Ward-Paige et al., 2013). Mobulids are usually not identified to the species level in bycatch reports but aggregate data indicate that bycatch mortality maybe large (Hall and Roman, 2013). This is of particular concern given the lack of information on mobulid stocks captured in these fisheries. *Mobula birostris, M. alfredi, M. munkiana, M. japanica, M. tarapacana, M. thurstoni, M. mobular*, and probably *M. eregoodootenkee* and *M. kuhlii* have been reported as bycatch in purse seines (Hall and Roman, 2013).

Recognizing the growing conservation concerns for mobulids, some countries have introduced pre-emptive measures to protect these species. All rays are protected from exploitation in the Republic of Maldives, while *Mobula* spp. are protected in Pakistan. In Indonesia, *M. alfredi* and *M. birostris* have been fully protected since 2014, and the protection of other mobuild species currently under review. In March 2013, reef (*M. alfredi*) and oceanic (*M. birostris*) manta rays were listed on Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). In 2016, the Parties to CITES also agreed to list all species of mobula rays on Appendix II. In addition to CITES, all mobulid species are now listed on Appendix I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), requiring Parties to coordinate with other range states to fully protect these species. In 2017, a regional IUCN assessment for the Arabian Seas and adjacent waters categorized *M. mobular* (previously *M. japanica), M. tarapacana,* and *M. thurstoni* as Endangered; *M. alfredi* and *M. birostris* as Vulnerable; and *M. eregoodootenkee* and *M. kuhlii* as Near Threatened (Jabado et al., 2017).

Despite these efforts there are no current regional management plans in place to ensure the future of mobulid populations. At the 22nd Session of the Indian Ocean Tuna Commission Proposal titled, 'On the conservation of mobula and manta rays caught in association with fisheries in the IOTC area of competence' was deferred (IOTC-2018-S21-PropL) on the basis that there was no specific research indicating an association of mobulids with surface fisheries, and requested the Scientific Committee of the IOTC to review the status of manta and mobula rays and their interactions with IOTC fisheries and report this to the Commission in 2020.

Bycatch of Mobulids in Pelagic Fisheries in the Indian Ocean

Mobulids have been reported as bycatch in 30 small and large-scale fisheries globally (Croll et al., 2016). Mobulids are also reported as bycatch in 21 small-scale fisheries in 15 countries using driftnets, gillnets, traps, trawls, and longlines. Of particular concern is a small-scale driftnet fishery for skipjack tuna

(*Katsuwonus pelamis*) off Indonesia with bycatch of *M. japanica*, *M. tarapacana*, *M. birostris*, *M. thurstoni*, and *M. kuhlii.* A partial survey of landing sites led to an estimated take of 1,600 individuals per year with fishery-wide bycatch significantly greater (White et al., 2006).

Industrial Fisheries (purse seine and longline)

The global tuna purse seine fishery may be a particularly important source of mobulid bycatch, with mobulids reported as bycatch in five tuna fisheries from eight countries (Croll et al., 2016). Tuna purse seine nets extend from the surface to depths of up to 130 m (Hall and Roman, 2013) and are used in three types of sets of which school sets (sets directly on tuna schools, not aggregated under floating objects) have the greatest mobulid bycatch (Hall and Roman, 2013). Mobulids and tunas have epipelagic tropical distributions in regions of high productivity, leading to a high degree of distributional overlap (Anderson et al., 2011; Croll et al., 2012).

The frequency of mobulid capture in these fisheries may be low, or systematically not reported. Considering the high fishing effort in the Indian Ocean, the total annual captures are likely to exceed sustainable exploitation of these slow growing species. In the Indian Ocean, the tuna fishery is dynamic and comprises of small-scale fishing vessels (less than 24 m), but also of vessels which are greater than 24 m and fish outside the EEZ, and vessels which are semi-industrial and larger than 24 m targeting large pelagics, including tuna and tuna like species.

There are large-scale industrial fishing vessels (purse-seine and longline) operated by distant water fishing nations and the use of floating objects, i.e. FADs is common. It is reported that these vessels had very poor observer coverage altogether and only ~8% of fishing effort is monitored, but *M. birostris, M. tarapacana* (*M. coilloti*), *M. mobular*, and *M. japanica* (*M. rancurelli*) have been reported as bycatch (Amande' et al., 2008). Using Amande' et al. (2008) reported bycatch of 77 mobulids across 1,958 net sets (2003-2007), it was estimated that 0.04 mobulids per set were captured. Combining this with the average annual effort for the fishery yields an estimated total mobulid take of 1,936 mobulids per year (Croll et al., 2016). It is also reported that between 1998 and 2009, mobulid landings increased significantly (from 200 to 5000 metric tons per year) (Ward-Paige et al., 2013).

Tuna drift gillnet fisheries

Six mobulid species have been reported to directly interact with tuna drift gillnet fisheries in Pakistan, and the analysis of commercial landings revealed that mobulids are found almost throughout the year (Nawaz and Khan, 2015). In the Philippines, the monitoring of the targeted fishery reported an average catch of 2,143 mobulids per season with an average CPUE of 0.18 catch per fishing hour over the season and a maximum monthly CPUE of 1.5 catch per hour, comprising of four species (Rambahiniarson et al., 2018). Data collected at 2 landing sites in Sri Lanka were extrapolated for 16 landing sites to create estimated annual landings of over 50,000 individual mobulas and of over 1,000 mantas (Fernando & Stevens, 2011). Recent data from Sri Lanka (2011-2015) revealed that from just 8 landing sites, over 1,000 mantas and

41,000 mobulas are landed each year (Fernando & Stewart, unpublished data), and as such it is likely that this number is much higher if all national landing sites are accounted for, in addition to the artisanal coastal fisheries that land at all the beach landing sites. These fisheries in Sri Lanka primarily utilise gillnets (and longlines) that are intended to target tuna. India, Indonesia, and Sri Lanka comprise of the top three manta fishing countries and account for an estimated 90% of the worlds manta catch for their gill plates (Nair et al., 2014). A recent study on small-scale drifting gillnet fishery for neritic tunas conducted in East Java, Indonesia (FAO major fishing area 51) indicate that interactions with mobuilds occurs throughout the fishing season (August to February), with a CPUE of 5kg per operational hour. The dominant mobulid species in the catch was *M. japonica*, with *M. tarapacana* and *M. thurstoni* also present (Harvey et al. 2018).

Table 1: A summary of information gathered on mobulid ray interaction with surface tuna fisheries in the IOTC area of competence.

Country	**Fishery type**			**Gear Type**			**Target Spp.**	**Mobulids**		**Mobula spp.**	**Trend**	**Source**
	Art	**SS**	**Ind**	**GN**	**PS**	**LL**		**Byc**	**Trg**			
Pakistan	X	X	X	X			Tuna	X	X	6	Declining	Khan and Nawaz, 2015
Sri Lanka	X	X	X	X		X	Tuna	X	X	5	Declining	Fernando and Stevens, 2011
Philippines	X	X		X			Tuna/Pelagic	X	X	4	Declining	(Alava et al., 2002; Acebes,2009) (Camhi et al., 2009). Rambahiniarison *et al.* 2018
Indonesia	X	X	X	X	X	X	Tuna	X	X	6 spp. (M. japanica, M. tarapacana, M. birostris, M. thurstoni, M. kuhlii, M. alfredi)	Declining	Dewar, 2002; White et al. 2006a, A.Marshall, pers. obs.). Dewar, 2002; Heinrichs et al., 2011); Harvey et al. (2018).
India	X	X	X	X			Pelagic coastal	X	X	6 spp.	Declining	(Mohanraj et al., 2009;

							fisheries					Fernando,2012) (Nair et al., 2014)

Target Mobulid Fisheries

In the Philippines, targeted mobulid fisheries captured an average of 2,143 mobulids per season (from November 2012 – February 2017), with an average CPUE of 0.18 catch per fishing hour over the season and a maximum monthly CPUE of 1.5 catch per hour. The catch composition in the area was dominated by *Mobula thurstoni* (bentfin devil ray, 63%) and *M. japanica* cf. *mobular* (31%) which together represented about 150 tons of biomass landed, followed by *M. birostris* (4%), and *M. tarapacana* (2%). Different species were regularly caught in the same net (Rohner et al. 2017; Stewart et al. 2017), including males and females of all life-stages, from newborn to pregnant females (Rambahiniarison et al., 2018).

This targeted mobulid fishery is now banned in the Philippines. However, bycatch persist in tuna fisheries occurring in the same region. Tuna fisheries use over 800m long drift gillnets, stretching vertically from the surface down to 10-15m depth. The tuna fishery landing in Jagna, bycatch include various elasmobranch species such as mako sharks (*Isurus* spp.), thresher sharks (*Alopias* spp.), and juvenile silky sharks (*Carcharhinus falciformis*), along with an average of 252 mobulids per season (Table 2). While those species are unlikely to be able to sustain high levels of bycatch (Rambahiniarison et al., 2018). The fisheries data from the Philippines (Table 2) shows that mobulids are extremely vulnerable to surface fishing nets in pelagic habitats.

Table 2. Total mobulids catch landing records per fishing season.

Monitored fishing season	**Total catch recorded from targeted mobulid boats**	**Total catch recorded from tuna fishing boats**
November 2012-May 2013	2,303	NA
January 2014-June 2014	1,890	NA
November 2015-June 2016	2,655	271
November 2016-February 2017	1,725	233

Mobulid Target Fisheries – Small-scale Fisheries

Mobulids have been targeted historically in small-scale (mostly artisanal) and commercial fisheries. Currently at least 13 fisheries in 12 countries (Pakistan, India, Sri Lanka, Indonesia, Philippines, Taiwan, Mozambique, countries around the Red Sea such as Egypt and Palestine) target mobulids with most of the fisheries being characterized as artisanal (Croll et al., 2016). Artisanal fishing, however, can have significant population-level impacts on mobulid populations (Rohner et al., 2013. Off Praia do Tofo in Mozambique, a 88% decline of reef manta rays between 2003 and 2011 has been attributed to artisanal fisheries. A meta-analysis of historical catch and effort data for Indonesia indicated that while effort within target mobuild fisheries has increased, landings have declined. For example, an artisanal mobuild fishery in the Lamakera region of East Flores has grown from a fleet of 18 unmotorized vessels in the late 1990's to 57 motorized vessels in 2013, with catches decline from 2,400 to 213 individuals per year over the same period (Lewis et al., 2015).

Management Issues and Challenges for Mobulid Conservation in the Indian Ocean

It is challenging to quantify the impacts of fisheries on mobulid populations since fishery data are relatively limited throughout the Indian Ocean. In most cases there are issues related to species identification (Camhi et al., 2009) resulting in misidentifications. However, in most cases, mobulid captures are simply not reported. In some fisheries (e.g. tuna purse seines), mobulids may be captured as bycatch but are released alive (Poisson et al., 2014). However, post capture survival is largely unknown, however, studies undertaken in New Zealand from purse-seine fisheries have revealed that four out of seven of M. mobular survived (Francis and Jones 2016). Similarly, in the tuna drift gillnet fishery of Pakistan, mobulids are captured and released alive but a small fraction is retained and landed. Post capture survival also needs to be further investigated, but is likely to be low. Moreover, the extensive use of drift gillnets on the high seas (banned according to UN resolution 46/215 and resolution 12/12 of IOTC) also poses a serious threat to dwindling populations of mobulid rays, in addition to issues of ghost nets. Given the indications of low post-release survival, as well as a need to establish handling and release best practices within the fisheries, there is also an urgent to develop and improve strategies that will minimise interactions in the first place.

Discussion and Recommendations

Based on the information made available through this report, it is evident that mobulid rays interact with surface tuna fisheries and are vulnerable due to their biological characteristics. However, the magnitude of these interactions (particularly bycatch) is poorly documented. However, it is clear that there is an urgent need for robust management measures to be adopted by the members of the Indian Ocean Tuna Commission (IOTC).

The data presented reveals that mobulid rays are found in epipelagic habitats in both coastal and offshore waters. They are caught in purse seines, gillnet and other fisheries. These numbers coupled with the low rates of reproduction is estimated to have a severe effect on of mobulid populations. Considering this, and that the Parties to CITES and CMS have provided mobulids a higher status of protection, we propose the following recommendations be considered for adoption by the IOTC:

- To improve data collection of mobulids ray interacting with tuna fisheries in the IOTC Area of Competence by species, size, length, weight, where applicable, including those that are released alive, discarded, retained or landed.
- To adopt measures for mandatory safe release of mobulid rays in purse seine, gillnet, longline and other fisheries operating in the IOTC Area of Competence and to adopt best practices such as those recommended in document WCPFC-SC8-2012/EB-IP-12 (Poison et al*.,* 2012. Good practices to reduce the mortality of sharks and rays caught incidentally by the tropical tuna purse seiners).
- To improve research to mitigate fishery interactions with mobuild rays and enhance gear selectivity.

- To adopt measures and encourage provision of satellite tagging programmes for released mobulid rays from purse seine, longline and gillnet vessels operating in the IOTC area of competence to assess post-release mortality.
- The draft resolution IOTC-2017-S21-PropCE_-_On_Conservation_of_Mobula_Manta proposed by the Republic of Maldives may be adopted incorporating the above said recommendations.

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